

Baffin Bay Elusive Plays: Geological Surprises of an Arctic Exploration Campaign

**Martin Grecula¹, Stephanie Wadsworth¹, Dominic Maloney², Hermann Lauferts³, Graham Cooke¹,
Adrian Jones², and Snezana Stevanovic²**

¹Shell International Ltd, London, United Kingdom.

²Shell International Exploration & Production, The Hague, Netherlands.

³Salym Petroleum Development, Moscow, Russian Federation.

ABSTRACT

Early regional evaluation of the frontier Baffin Bay acreage, offshore NW Greenland, identified a tilted fault block play in rifted Melville Bay and Kivioq basins, assuming reservoir-prone pre-rift lithology, charged by Cretaceous syn-rift source rocks. The exploration program started with a shallow coring of near-seabed inverted stratigraphy, aiming to reduce stratigraphic uncertainty and its impact on petroleum systems. The cores confirmed significant thickness of Cretaceous terrestrial and marine source rocks, but showed that pre-rift sequence is most likely of Precambrian age and devoid of reservoir rocks. The core changed the entire regional evaluation and proved the majority of the leads identified pre-bid were no longer viable. The focus shifted to the post-rift succession, above the basal Tertiary break-up unconformity. A newly acquired 3D seismic survey revealed a large Paleogene turbidite fan system sourced from the uplifted hinterland. The initial subtle traps were defined by lateral and updip stratigraphic pinchouts, aided by differential compaction. An inversion event, associated development of several regional unconformities, post-dates the deposition of presumed Paleogene reservoirs and indicates a switch to a compressional tectonic regime, which locally created new structural traps. Further seismic reprocessing suggested Mesozoic reservoirs may co-exist alongside the Proterozoic in the pre-rift structural closures. Nevertheless, the portfolio is dominated by sizeable, but risky Paleogene stratigraphic and combined traps. The lack of calibration, especially in the Tertiary section, made it essential to utilize loop-level seismic interpretation to de-risk reservoir interpretation, define/de-risk subtle traps, and improve volumetric definition. Due to large age uncertainty of the Tertiary stratigraphy, as well as timing of the hydrocarbon expulsion and trap forming events, a scenario-approach was used to define the range of possible charge realizations. The basin modeling results, supported by local presence of shallow seismic hydrocarbon indicators, suggest the charge in the basin is likely, which, however, contrasts with the fact that AVO anomalies in the prospective intervals are sparse, and inconclusive. The Baffin Bay remains an intriguing exploration frontier, but further risk reduction will require a well to prove not only a working petroleum system, but also significant hydrocarbon volumes to justify a challenging development.